Earthquake Prediction Using Ionosphere Coupling Theory of Seismo-Electromagnetic Phenomenon

Geeta1 , S.Choudhary2 , Purvee Bhardwaj3, Neetu Paliwal4

Geeta (glather143@gmail.com) Research scholar, RNTU,BHOPAL

S.Choudhary(Csuryanshu@gmail.com) SAM Global university, BHOPAL

Purvee Bhardwaj (purvee.bhardwaj@gmail.com) RNTU , BHOPAL

Neetu paliwal (neetu.paliwal@gmail.com) RNTU , BHOPAL

Abstract

Electromagnetic surveillance satellites have a broad prospect in the field of seismic monitoring and prediction as an important way of studying the Earth's electromagnetic environment. The electromagnetic seismic satellite obtain the electromagnetic field and environment of the ionosphere by transporting electromagnetic field, plasma and high energy payloads the information and disturbances.. The satellite works with the global satellite navigation system and ground beacon measuring system to obtain the ionospheric construction and its information changes below the satellite orbit, thereby providing effective technical means for the study of electromagnetic disturbance legislation and mechanisms relating to earthquakes. Proposed method The prediction of an earthquake using the ionosphere coupling principle

Keywords: earthquake precursors, Ionosphere Coupling, Electromagnetic Phenomenon

Introduction

A multiplicity approach includes various branches of atmosphere science and meterology, atmospheric chemistry, aeronautics, aerospace, plasma physics, and space atmosphere. The study involves a multidisciplinary approach . The study includes In this document we analyze from the point of view of the coupling of troposphere-ionosphere the findings of low-frequency electromaintic waves in the cavity. By lighting and occasional light events in low altitude and precipitation of heat and magnetization-related particles in alfven waves, we shall discuss electromagnetic wave phenomena growth, propagation and resonance. We investigate surface and space weather anomalies and ionosphere ionizing processes. The impacts on the aerosol atmosphere and electromagnetic waves, the allotment of water vapor, thermodynamic parameters, We examine the role of the lower limbs in cavities, transient surface phenomena, including seismic activity, earthquakes, volcanic processes and dust electrification. We analyze the role of the transient surrounding surface phenomenon in these areas. The role in ionospheric dynamics of surface disturbances and atmovable waves is also addressed briefly. We summarize analytics and numerical tools and techniques for modeling low-frequency wave propagation and for solving opposing problems and outline in the finishing line a number of challenging topics which are important for our understanding of tropospheric ionospheric coupling. Two separate projects are currently underway. The first focuses on efforts to improve existing ionosphere models of all types , i.e. the mean conditions observed during the predictive period beyond their climatic level. To date vast volumes of ionospheric data have been obtained and analyzed from different ground and spatial measurements in order to incorporate data and models into assimilative systems.and/orTo predict or correct propagation effects for specific radio applications, to construct patterns of space weather events and effects that are most suitable for a specific place and requirements of the user. The second development is to use the data in real time to give an immediate ionosphere a more precise specification. Enhanced solar-terrestrial monitoring techniques and rapid progress in computer and digital communication technologyA variety of real-time data and ionospheric database systems options have been developed. In this respect, real-time data streaming by DIAS, GIRO (Global Ionospheric Radio Observatory) and other global and/or regional networks provides at least hourly updated ionospheric data, along with the continuous flow of corresponding solar-earth data worldwide, is essential for current and future developments.

Related Work

Hayakawa, M., Hobara, Y., Ohta, K., & Hattori, K. (2011).This review addresses the ULF magnetic field variation as the direct result of the lithospheric precursory effect. While the radio emissions are produced as a pulse in the EQ hypocenter, higher-frequency components can not spread over long distances in litosphere because of extreme attenuation, only ULF waves can spread with a small attenuation to the observation point close to the earth 's surface.

Sorokin, V. M., & Yashchenko, A. K. (2016) The equations show that the amplitude of the distributed wave field is much greater than the amplitude of the diffraction wave below the horizon. The theoretical findings support the observations behind the horizon of the electromagnetic radiation and the VHF transmitter signals in respect to the earthquake epicentre.

K. FLORIOS et al(2019)In general , two so close-to-one earthquakes (in space , time and magnitude) provide a singular opportunity to explore the characteristics of the ULF / ELF pre-seismic disturbances.

Quantitative results from a simple nonlinear statistical model support the idea that seismic and atmospheric ELF activities have some form of natural interaction with one another and that measurements of ELF may potentially be used in seismic activity forecasts..

Masashi Hayakawa(2016) This paper examines this short-term EQ provision and includes the impossibility myth of the EQ's seismometer prediction; why we are interested in electromagnetics, the seismo-electromagnetic history, the ionospheric disturbance as the most promising candidate for EQ provision; and then the future of EQ prediction from two practical scientific and pure science viewpoints.

Vittorio Sgrigna[1] and Livio Conti(2012)The paper is designed to give proposals for a deterministic approach to the prediction and warning of possible earthquakes. Observations and physical modelling of earthquake precursors, which see the phenomenon earthquake in perspective in a common theory able to explain the causes of the earthquake and its preparation, incidence, post-sismic relaxation and interseismic phases in dynamics, rheology and micro physics can make a fundamental contribution. Combined earthquake precursor observations studies are vital for tackling the problem.

Proposed Approach

1. The satellite system design needs to solve the problem of unstressed synchronous, independent observation of sensing object like electric field , magnetic field, plasma and high-energy particles.

2. Efficient calibration of loads requires high ground system accuracy. The efficient method of load calibration is diversified and the control is complex.

3. The magnetic cleanliness must be monitored by the satellite body. 4. The satellite features two kinds of roll-out mechanism, a type of hinge and a type of roller, with roll-over lengths of more than 4 meters.

Characteristic Analysis of Electromagnetic Seismic Satellite The basic information of the launched

A collection and detailed review is made of typic electromagnetic sismic satellite. This is visible: 1. There is a variety of physical quantities of electromagnetic seismic satellite sensing and a variety of electromagnetic detection charges are provided for the Satellite Platform.

2. Factors like the anti-interference design of electromagnetic detection should be taken into consideration when designing the satellite body, and several satellites take different design measures including extension mechanisms to resist electromagnetic intervention.

3. The high-tilt angle (> 79 °) orbit is chosen in the orbit of the satellite. The explanation is the "seismic activity" detected by a high inclination orbit, which is the best way to catch the ionsopharyngeal precursors, is the local time. At the same time , a high tilting angle also contributes to the observation and investigation of the global geomagnetic and ionospheric fields

.4. The orbit satellite is about 400 to 800 km high, and the orbit height is regarded mainly as an integrated compromise here between ionosphere and electromagnetic high-sensitivity detection.

5. The majority of the satellites use small satellite experimental platforms.

. 6. In recent years , small satellite networks have developed in order to monitor electromagnetically.

In the global multi-regional early warning, which illustrates thoroughly the advantages of electromagnetic disruption in the slow-moving earthquake forecast the electromagnetic seismic satellite played a positive role after years of research and practice. However, numerous scientific and technological problems still need to be studied further, for example:

1. More analysis is essential for the inner relationship between seismic and electromagnetic characterisation. It is very complex and it requires further analysis to relate electromagnetic variability characteristics to earth-seismic activity. More understanding of this problem is the more satellite detection can be promoted by the more electromagnetic detection methods to achieve early warning objectives.

2. Further study on how to eliminate interference in electromagnetic surveillance. The satellite payload information is the complete impact of results for detection of multi-information source .. How interference with detection results can be eliminated and seismic precursor information extracted is a problem which must be resolved.The payload operates in the satellite setting and primarily interferes from the exogenous area, namely the solar system, the satellite itself, the atmosphere of the satellite, the ground, data transmission, load interference, etc. The mechanism of seismical electromagnetic coupling must be clearly understood in order to derive seismic precursor information from such complicated information.Therefore the role of seismic electromagnetic coupling must be studied with a breakthrough. An efficient way of obtaining the variability rule of EMS before and after the earthquake is also by means of statistics on seismic electro-magnetic disturbances, but the restriction of observation data still presents some difficulties. Interferon source is examined one by one, to eliminate interferon and the seismic precedent information is determined by combining this with observation on the ground. The interferon source is then analyzed one by one, to prevent interference.

3. This calls for a comprehensive review of how the data used for the early warning analysis of earthquake precursors are used in their entirety. The vast actual detection data collected by the Earthquake electromagnetic satellite in-orbit is the required method for developing the electromagnetic satellite's applications in order to use a range of technological instruments to thoroughly analyze electromagnetic detection data.

4. Study is needed to optimize platform design and improve performance detection indicators. The characteristics of electromagnetic load design, work setting, work mode, technical indicators, and other factors make device design important to continually research new theory, process, and new patterns. Boost structures or constellations at design stage.

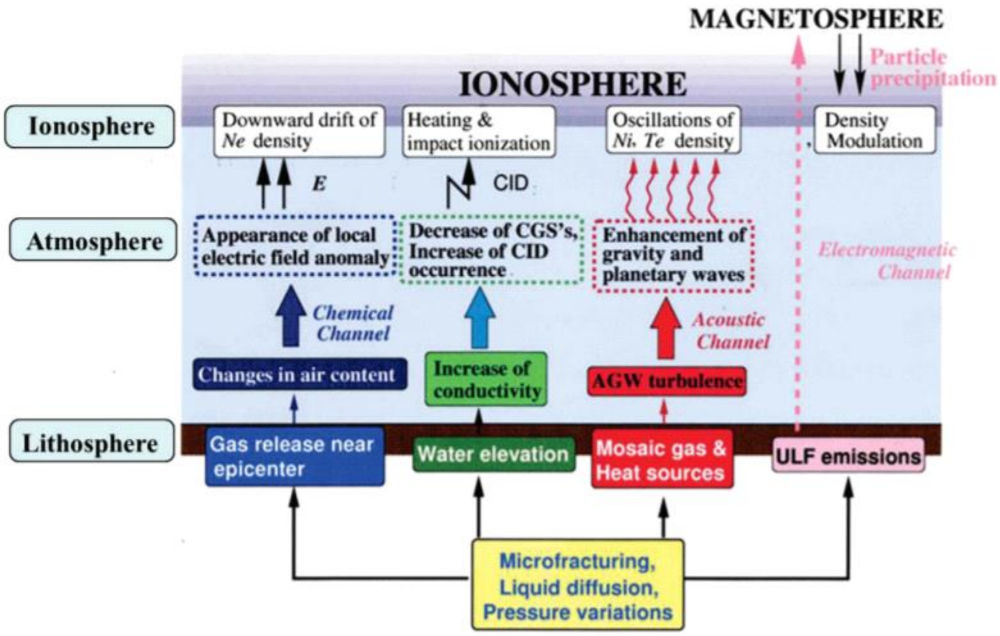

Figure 1: Schematic illustration on the lithosphere-atmosphere-ionosphere coupling, and three possible hypotheses of (i) chemical channel, (ii) acoustic (or atmospheric oscillation) channel, and (iii) electromagnetic channel

5. Whether to incorporate spatial and ground-based detection media needs more research. In spite of the satellite multiple electromagnetic related tools, the electromagnetic precursor of electric, magnetic field can however be identified with earthquakes and volcanoes, and Data on the electromagnetic field has been explored and no systematic multidisciplinary testing exists. The mixture of the satellite must therefore consider research and development as a ground observation and geophysical monitoring instrument; seismic electromagnetic observation physical satellite instruments with ground electromagnetic observation are very important for the satellite to form a whole set of geomagnetic observations. Long-term and continuously observing the Electro-magnetic observation system and the ground instrument. The ground-observation-point should also include comprehensive multidisciplinary observation (such as GPS, geophysical and deformation observation, etc.), in order to fully understand and summarize and identify possible precursor-related earthquake earthquake-based electromagnetic anomalies and to achieve the objective of earthquake.

How an early warning system can be established needs to be studied further. The start of seismic precursor detection is the launch of a single electromagnetic satellite. It must be carefully investigated how to make full use of a multistar network to integrate a variety of detection methods (for example GPS, gravity, INSAR, infrared and other satellites).

Lithosphere and Ionosphere Coupling

The study of the geophysical phenomenon before, during and after a seismic event in the last few decades has greatly increased. Numerous scientists from various disciplines have studied this, including, obviously in addition to seismology, hydrology, geomagnetism, atmospheric physics, geochemistry and ionospheric radio propagation. The study of the couplementing of the lithosphere and ionosphere, with a possibility to establish an ionosphere cause of earthquakes, has been carried out or is in progress with experimental observations both on grounds and from space satellites. These studies have produced a large number of papers in scientific literature and submitted them to the URSI and the European Geophysical Union general assemblies in special sessions at international conferences. The Section presents a very short overview of this topic, delineating the main mechanism hypothesis that explains the coupling of the lithosphere-ionosphere and the perplexities that animated the associated scientific debate. In addition, the ionospheric effects of lithospheric anomalies should be considered in conjunction with a greater class of studies known as seismic events' electromagnetic effects.In such studies, the wideband electromagnetic radiation recorded on the Richter scale just before a Grade 7 earthquake should be mentioned. After the radio noise levels at 81 kHz have been relatively quiet, an anomalous amplitude rises by 15 dB above normal. The radio noise amplitude returned to normal levels only after the incident.Anomalous VLF (3 –30 kHz) variations and ELF (neutral atmospheric decrease so that movement in the range of millimeter over the surface extends to kilometers of distances at ionospheric heights, not only after an earthquake but also after an earthquake, the mechanism of the AGW, apart from the well-known TIDs excited at lower atmosphere from weather fronts is observed..The source of AGWs, as emphasized by V.A. Liperovsky, is probably the long-term earth- or sea oscillations in the case of tsunami that spread to the ionosphere. During the last ten years of the S. K and Pulinets. In order for Bordachuk to explain some anomalous changes in ionosphere, ioosphere measurement and gas emission to the earth in a sismogenetic region were taken into account and correlated with it.The emanation from the ground of various chemical substances such as radon, helium, hydrogen and submicron and metal aerosols, changes the electromagnetic properties of the atmosphere over an earthquake-induced field. The radon that comes from the crust is a major source of ionisation and clusters of heavy ions in the near-ground atmosphere layer create a further electric field that overlaps the total electric field (ionosphere-growth). Due to the electrode effects in the atmosphere on the earth, the production of an electric field leads to small scale irregularities in the E region and to large scale ionosphere irregularities. See the above-mentioned volume for details and recent developments in this model. With regard to future developments in such research , it is important to point out that international organizations are funding experimental projects that are focused on space satellite measurement. It should be noted that the French CNRS sponsored, and M-led, DEMETER satellite experiment. Lotus. This satellite is used to analyze seismo-electromagnetic effects in the ionosphere and is designed to detect ion composition, electron density and temperature, energetic particles and broad frequency emissions of ELF-VLF, which are known to be the cause to seismo-seismic events and volcanic eruptions within a few hours.Satellite measurements that cover larger seismic areas, unlike ground-based ionosphere vertical sounding which could be limited to a single point or too far away from the epicentre, but measurements need to be checked against those taken on the earth's surface. The Sea surface monitors by the HF OTHR can be considered in this context as a Langmuir probe, electrical and magnetic sensors and an energy spectral analyser.. It is now obvious that electromagnetic seismic precursors and the possible effects on the ionosphere should not be ignored and further investigated to exceed the status of electromagnetic seismic precursors only a posteriori is identified. Most statistical studies have been done on fluctuations in normal or even ionospheric mean hourly values, posing the question of whether the effects found are large enough to outweigh natural ionospheric variability caused by other factors.

Conclusion

In order to integrate the earth and space, network and global detection, the international electro-magnet satellite has been vigorously developed. In the future the current development of technology will further deepen and further explore the Earth's electromagnetic system and mechanisms The ability to predict earthquakes will further enhance. An integrated, multi-dimensional pattern of ionospheric changes involving observing systematic data and calibration procedures is needed to establish theory and modeling of the Earth's top atmosphere, which are focused on globally organized modern technology, in order to achieve an effective prognosis and forecasting for the 21st century.

Reference

- K. FLORIOS, 1,3 I. CONTOPOULOS, 1 V. CHRISTOFILAKIS, 4 G. TATSIS, 4 S. CHRONOPOULOS, 4 C. REPAPIS, 2 and V. TRITAKIS1,(2019) Pre-seismic Electromagnetic Perturbations in Two Earthquakes in Northern Greece Pure Appl. Geophys. 2019 Springer Nature Switzerland AG https://doi.org/10.1007/s00024-019-02362-6.
- Hayakawa, M., Hobara, Y., Ohta, K., & Hattori, K. (2011). *The ultra-low-frequency magnetic disturbances associated with earthquakes. Earthquake Science, 24(6), 523–534.* doi:10.1007/s11589-011-0814-2
- Masashi Hayakawa(2016)” Earthquake prediction with electromagnetic phenomena” Cite as: AIP Conference Proceedings 1709, 020002 (2016); https://doi.org/10.1063/1.4941201 Published Online: 01 February 2016
- Zhang, X., Zhuang, H., Yang, G., Liu, Y., Fang, H., Qin, W., … Chen, X. (2018). *Reviews and Prospect of International Electromagnetic Seismic Satellite. Advances in Astronautics Science and Technology.* doi:10.1007/s42423-018-0021-5
- Sorokin, V. M., & Yashchenko, A. K. (2016). *Anomalous propagation of VHF radiowaves behind the horizon in the seismic region. Geomagnetism and Aeronomy, 56(6), 761–773.* doi:10.1134/s0016793216050133
- Vittorio Sgrigna[1] and Livio Conti(2012),” A Deterministic Approach to Earthquake Prediction“Volume 2012 |ID 406278 | 20 pages | https://doi.org/10.1155/2012/406278

- De Santis, A., Balasis, G., Pavón-Carrasco, F. J., Cianchini, G., and Mandea, M.: Potential earthquake precursory pattern from space: The 2015 Nepal event as seen by magnetic Swarm satellites, Earth Planet. Sc. Lett., 461, 119–126, https://doi.org/10.1016/j.epsl.2016.12.037, 2017.
- Donner, R. V., Potirakis, S. M., Balasis, G., Eftaxias, K., and Kurths, J.: Temporal correlation patterns in pre-seismic electromagnetic emissions reveal distinct complexity profiles prior to major earthquakes, Phys. Chem. Earth, 85–86, 44–55, 2015
- Marchetti, D. and Akhoondzadeh, M.: Analysis of Swarm satellites data showing seismo-ionospheric anomalies around the time of the strong Mexico (Mw = 8.2) earthquake of 08 September 2017, Adv. Space Res., 62, 614–623, https://doi.org/10.1016/j.asr.2018.04.043, 2018
- Pulinets, S., Ouzounov, D., and Davidenko, D.: The possibility of earthquake forecasting: learning from nature, Geophysical Research Abstracts, Vol. 20, EGU2018-9191, EGU General Assembly, 2018
- Schekotov, A. and Hayakawa, M.: Seismo-meteo-electromagnetic phenomena observed during a 5-year interval around the 2011 Tohoku earthquake, Phys. Chem. Earth, 85–86, 167–173, https://doi.org/10.1016/j.pce.2015.01.010, 2015.
- Enomoto, Y., 2011. Modelling of source mechanism for seismoelectromagnetic phenomena, in The Frontier of Earthquake Prediction Studies, pp. 612–622, ed. Hayakawa, M., Nippon Tosyo Shuppan, Tokyo (in Japanese).
- Hayakawa, M, Earthquake Prediction with Radio Techniques (John Wiley & Sons, Singapore, 2015), p 294.
- Biagi, P. F. and A. Ermini, Geochemical and VLF-LF radio precursors of strong earthquakes: A review, in Earthquake Prediction Studies: Seismo Electromagnetics, edited by M. Hayakawa (TERRAPUB, Tokyo, 2013), 153-168.